SECTION 928 FORMED RUMBLE STRIP:

928-1 Description:

The work under this section shall consist of forming rumble strips in the asphaltic concrete roadway shoulders at the locations shown and in accordance with the details on the plans and the requirements of these specifications.

928-2 Construction Requirements:

Rumble Strips shall be formed in the asphaltic concrete by making indentations a minimum of 30 millimeters deep by 600 millimeters in length and spaced at centers of approximately 200 millimeters. in accordance with the details shown on the project plans.

The indentations shall be formed by rolling the asphaltic concrete. while still hot with a tandem roller weighing not less than 10.8 metric tons. The roller shall have segments of 60 millimeter outside diameter pipe welded to the driving roller drum.

The pipe segments shall be 600 millimeters long, cut longitudinally to provide a half segment, and capped on the ends. The pipe segments shall be welded to the roller drum at approximately 200 millimeter centers, with the rounded side of the pipe away from the drum.

If the rear tires are pneumatic. they shall have a smooth or slick tread design. The roller shall be equipped with an approved water system which will moisten the drums and tires so that the bituminous material will not be picked up. The roller shall also be equipped with an approved guide that extends in front of the roller and is clearly visible to the operator so that proper alignment of the strips will be obtained.

The equipment used shall be positioned by using planking. or by other approved means. so that the asphaltic concrete is indented only at those locations specified on the plans and to the dimensions specified herein and on the plans.

The forming of the Rumble Strips shall be accomplished in one pass of the equipment. The surface surrounding the indentations shall be smooth and nondeformed.

The asphaltic concrete shall be compacted to the degree specified in the appropriate section of the specifications.

928-3 Method of Measurement:

Formed rumble strips will be measured by the linear meter longitudinally along the edge of the shoulder on which the rumble strips are formed. Individual strips will not be measured for payment.

928-4 Basis of Payment:

The accepted quantities of formed rumble strips. measured as provided above, will be paid for at the contract unit price per meter, which price shall be full compensation for the item complete, as described and specified herein and on the project plans.

A POLICY ON

SHOULDER GROOVING FOR

RUMBLE STRIPS

FEBRUARY 15, I995

ARIZONA DEPARTMENT OF TRANSPORTATION

HIGHWAYS DIVISION

ROADWAY ENGINEERING GROUP

ROADWAY DESIGN SECTION

INTRODUCTION

The purpose of this policy is to define conditions where shoulder grooving will be placed on the state highway system roadways.

Shoulder grooving is an indented pattern placed in the new asphaltic concrete pavement surface of roadway shoulders to enhance safery. Shoulder grooving is intended to alert drivers by creating an early audible and tactile "rumble strip" warning that their vehicle is leaving the traveled way and that a steering correction is required.

The enclosed Construction Standard Drawing C-09.10 provides a detailed description of the pattern, placement, and method of construction.

This policy was developed jointly by the Roadway Engineering Group and Traffic Engineering Group, has been endorsed by the Regional Traffic Engineers representing the Engineering Districts and has received Federal Highway Administration review and approval.

POLICY

Shoulder grooving will be applied to new construction projects when the thickness of new asphaltic concrete shoulder will allow placement in accordance with Standard Drawing C-09.10, Grooving for Bituminous Shoulders. Shoulder grooving will be applied as follows:

Rural Areas

Shoulder grooving will be applied on undivided highway shoulders 6' wide and greater. On divided highways, grooving will be applied on right (outside) shoulders 6' wide and greater and left (median) shoulders 4' wide and greater.

Urban Areas

Shoulder grooving will not be applied on the shouiders of roadways within urban boundaries.

Suburban Areas

Shoulder grooving may be applied in suburban areas in accordance with the widths given for Rural Areas. The designer coordinating with the District representative, will determine the limits of shoulder grooving weighing considerations such as number nnd spacing of residential and commercial driveways posted speed limits/operating speeds. existing land use, future development, bicycle traffic, signalization, and accident history. When these considerations are more indicative of urban than rural conditions, shoulder grooving may not be appropriate.

Shoulder grooving on all shoulder widths, may be considered a remedial measure for site specific safety enhancements proposed by Traffic Engineering as a part of HES or other safety projects.

The Department will continue to search for and evaluate new products and process for rumble strips which can provide effective, economical alternates to shoulder grooving.

THO:tbw
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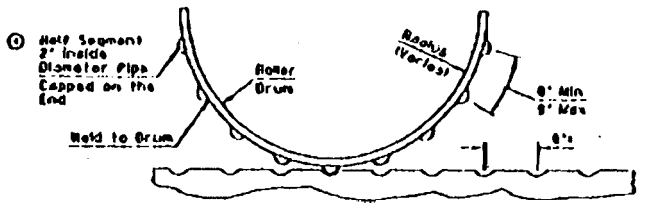
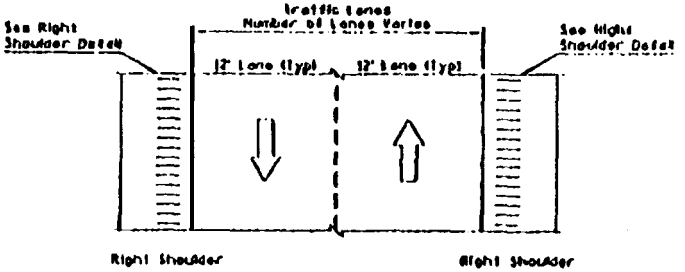
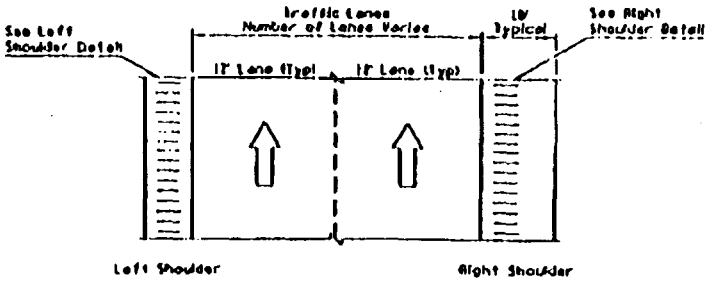


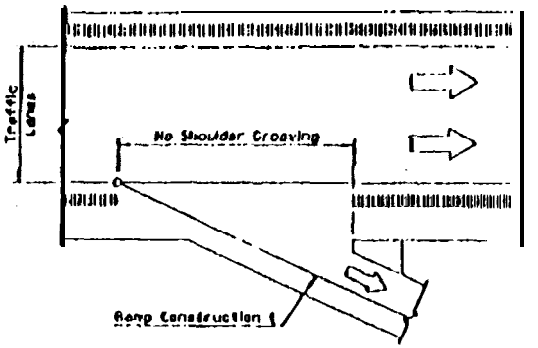
STEEL DRUM DETAIL



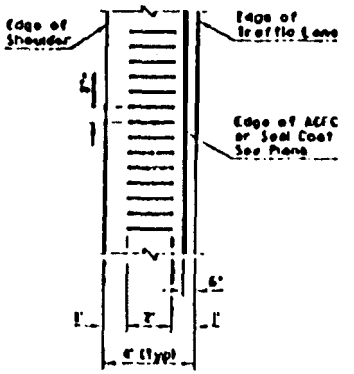
① TYPICAL SHOULDER GROOVING PLAN
FOR UNDIVIDED HIGHWAYS



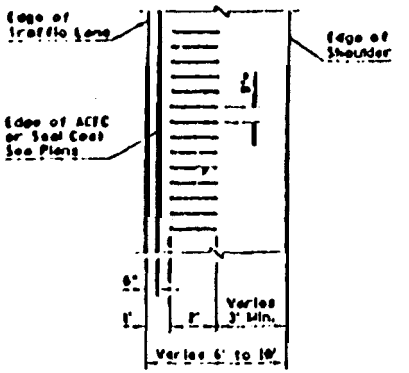
① TYPICAL SHOULDER GROOVING PLAN
FOR DIVIDED HIGHWAYS



① RAMP EXCEPTION DETAIL
ENTRANCE RAMP SIMILAR



① LEFT SHOULDER GROOVING DETAIL
FOR DIVIDED HIGHWAYS
TYPICALLY 4' WIDE



① RIGHT SHOULDER GROOVING DETAIL
SHOULDERS 6' AND WIDER

GENERAL NOTES

① 1. Shoulder Grooving shall be applied to the shoulders of rural highways when called for on the Plans in accordance with the following shoulder widths:
Undivided Highways - Shoulder 6' and greater
Divided Highways - Right shoulders 6' and greater
Left shoulders 4' and greater

2. Shoulder Grooving shall be omitted across principal intersecting roadways or other interruptions in normal shoulder width as directed by the Engineer.

① 3. Shoulder Grooving shall be constructed by making indentations in the asphaltic concrete.

The indentations may be formed by rolling the hot asphalt concrete with a roller to which half segments of 2" inside diameter pipe have been welded to the drum. The pipe segments shall be 2" long and spaced at approximate 6" centers.

4. Each roller shall be equipped with an acceptable guide that extends in front of the roller and is clearly visible to the operator in order that proper alignment of the completed scored shoulder is obtained.

5. The contractor may utilize other equipment or methods to construct the shoulder grooving if approved by the Engineer.

	STATE OF ARIZONA DEPARTMENT OF TRANSPORTATION DIVISION OF HIGHWAYS STANDARD DRAWINGS	3/93
	GROOVING FOR BITUMINOUS SHOULDERS	C-09.10

DRAFT
FEBRUARY 12, 1998

A POLICY ON

THE APPLICATION OF

CONTINUOUS LONGITUDINAL

RUMBLE STRIPS

ARIZONA DEPARTMENT OF TRANSPORTATION (ADOT)
INTERMODAL TRANSPORTATION DMSION
TRAFFIC GROUP

A . INTRODUCTION:

The purpose of this policy is to define when and where shoulder grooving (or continuous longitudinal rumble strips) will be applied on the state highway system. This document is to replace the Arizona Department of Transportation's (ADOT) "A Policy on Shoulder Grooving For Rumble Strips" which was issued February 15, 1995.

The purpose of continuous longitudinal rumble strips is to enhance safety by preventing run-off-road (ROR) type (collision with fixed object) accidents. These rumble strips are intended to alert drivers by creating an audible (noise) and tactile (rumble) warning that their vehicle is leaving the traveled way (traffic lane) and that a steering correction is required. Before and after accident studies have indicated that ROR type accidents may be reduced significantly by the use of continuous, longitudinal rumble strips.

ADOT current standard is to form longitudinal rumble strips into freshly placed asphaltic pavement. Recent developments have now made a variety of new continuous longitudinal rumble strip techniques feasible. Research and field tests have shown that cold milled or ground-in rumble strip technique is the most effective.

One of the other main advantageous to ground-in rumble strip is that they can be installed at anytime on almost any type of pavement surface. Thus, the installation of longitudinal rumble strips can be accomplished independent of paving operations with no corresponding exception to compaction requirements. It will also now be possible to install rumble strips on shoulders that are not scheduled to be resurfaced.

At the December, 1997 meeting of ADOT's Traffic Control Products Evaluation Committee (TCPEC) a resolution was passed to implement ground-in rumble strip technique as the new standard The plan to implement this change has been developed jointly by the Roadway Engineering Group, Traffic Group, Construction Group, Materials Group and the Federal Highway Administration.

This document contains the provisions that will transition ADOT from formed to ground-in longitudinal rumble strips. Once fully adopted these new provisions will replace the current Construction Standard Drawing **C-09.10** and stored specification for Section 928.

B. POLICY

Continuous longitudinal ground-in rumble strips will be applied to projects per the recommendations and requirements of this document

Longitudinal rumble strips will be normally be applied to projects that involve new roadway construction, reconstruction, widening, and pavement preservation Projects that do not involve the roadway driving surface will generally not involve longitudinal rumble strips, unless it is related to accident mitigation. Work is continuing on the consideration of a separate continuous longitudinal rumble strip project program.

The criteria for applying continuous longitudinal rumble strips has been divided into three general land-use type categories (rural, urban and suburban). Given the varied nature of land-use, the lack of clearly defined boundaries and the potential for future growth the designer will need to determine which category or categories apply to a project. It may be possible for a project to involve all three categories. Input from the District and local jurisdiction may be helpful in this regard.

Continuous longitudinal rumble strips will be applied generally as follows and per the requirements of the attached **Longitudinal Rumble Strip Application Table.**

(1) Rural Areas

On undivided highway with shoulders four (4) feet and greater continuous longitudinal rumble strips will be applied. The use of Iongitudinal rumble strips on undivided four lane highways and highways with narrower shoulders shall be evaluated on a case by case basis.

On divided highway, longitudinal nxnble strips will be applied on the right (outside) shoulders with a width of **four (4) feet or** more and on left (median) shoulders which have

a width of two (2) feet or more. The use of logitudinal rumble strips on divided highways with narrower shoulders that those noted shall be evaluated on a case by case basis.

The width of groove and location of the strip pattern used for all applications is to be based per the Longitudinal **Rumble Strip Application Table.**

The use of longitudinal rumble strips on all roadway shoulders less that four (4) feet wide with sections of guardrail and/or barrier needs to be evaluated. The effective width of the shoulder in these areas needs to be determined. The effective width is defined as the distance between the outside edge of the traveled way (inside edge of the edgeline) and the front face of the guardrail or barrier. To allow for installation a minimum effective shoulder width of 18 to 24 inches is needed between the front face of the guardrail or barrier to the outside edge of the ground-m rumble strip groove. If this width criteria can not be maintained then either the rumble strip needs to be moved closer to the traveled way or eliminated in the area of the guardrail or barrier.

(2) Urban Areas

Generally, continuous longitudinal rumble strips should not be applied on the shoulders of roadways within developed urban areas. These types of rumble strips can produce noise that may be objectionable to citizens that reside nearby. Therefore, consideration of using continuous longitudinal rumble strips in urban area should only be undertaken if there are no other reasonable alternatives and/or it is to mitigate a specific area problem.

If the longitudinal rumble strip is to be used an evaluation of possible citizen complaints and possible mitigation measures should be done prior to implementation. It is planned to evaluate the noise impact of continuous longitudinal rumble strip in the near future. Once this evaluation is completed then a more definite criteria statement in this area may be possible.

(3) **Suburban Areas**

Continuous longitudinal ruble strips may be applied in suburban areas in accordance with the criteria presented under (1) Rural Areas. However, the suitability of applying longitudinal rumble strips in these types of areas also needs to be carefully evaluated.

An evaluation that involves the responsible District should be conducted to determines when and where longitudinal rumble strips use is to be considered. This evaluation should investigate:

(1) The location of existing and/or future residential and commercial developments;
(2) The location of existing and/or future driveways and cross roads;
(3) Posted speed limits/ operating speeds (roadways with speed limits less that 45 mph should generally not include rumble strips);
(4) Future widening or shoulder areas designated as future traffic lanes;
(5) Possible other roadway improvements such as the addition of curb/gutter, sidewalks or walking paths;
(6) Close spacing of traffic signals;
(7) Heavy Bicycle traffic;
(8) Location of tied objects and steep cross slopes; and
(9) Run-off-road (collision with fixed object) type accident history.

When the findings of this evaluation indicate that the suburban area is more urban than rural in nature and a specific ROR accident mitigation issue is not involved, then the use of continuous longitudinal rumble strips may not be appropriate.

D. OTHER CONSIDERATIONS:

Continuous longitudinal rumble strips can be achieved per a number of different techniques and patterns (e.g. formed rumble strip, profile pavement markings or ceramic buttons). This policy is not intended to restrict or prohibit the use of any of these other alternatives. If a alternative technique is shown to offer an advantage over the ground-in rumble snip then its use should be pursued

Currently, the Traffic Group in association with Arizona Transportation Research Center (ATRC) and FHWA are field testing a number of different continuous longitudinal rumble strip techniques such as profile thermoplastic markings and ceramic buttons. Interested parties should contact the Traffic Group for more information regarding these possible alternative techniques.

DRAFT

Longitudinal Rumble Strip Application Table

Type of Roadway	Shoulder Location	Shoulder Width	Groove Width	Location	Comment
Undivided (narrow)	Both sides	At least 6". but less than 4'	5 inches	Guideline*	l&2
Undivided	Both Sides	4', but less than 6'	8 inches	Guideline*	Offset of 1' can be placed if shoulder width 5' or more.
Undivided	Both Sides	6' or more	8 inches	1' offset from Guideline*	
Divided (narrow)	Left	At least 6", but less than 2	5 inches	Guideline*	1&2
Divided	Left	2'. but less than4'	8 inches	Guideline or 4 inch offset*	
Divided	Left	4' or more	12"	1' offset from Guideline*	
Divided (narrow)	Right	At least 6", but less than 4	5 inches	Guideline*	l&2
Divided	Right	4' or more, but less than 6'	8 inches	1' offset or Guideline*	
Divided	Right	6' or more	12 inches	1' offset from Guideline*	

Notes:

*** Guideline is** where the rumble strip and edgeline arc at the same location.

1. Full width surface treatment is required across the entire roadway (lanes and shoulder).

2. Lane widths, if greater than 12 feet should be reconfigured to 12 feet prior to the installation of the rumble strips to insure that shoulder widths have been maximized.